

Woody: ... to get some range in time. To begin with, and some range of influences. And if you think there are some people who have input in it or who have inspired you. I caught you in the Vidiom period.

Bill: I remember, that's true. Where I was at the...

Woody: I would be interested how that ever happened.

Bill: Well, you caught it fairly late when I was at the Exploratorium, I was a curator there. And I had designed before I went there a really large console that made complex color lissajous patterns. Multiple locked oscillators and pseudo-three dimensional shapes. I always thought they were quite beautiful. They'd been used in a couple of different applications. But I made a large console that would generate great families of them. You saw that.

Woody: Yes. Where were you at that time?

Bill: When I met you I was at the Exploratorium, as curator.

Woody: Were you employed?

Bill: Sure. I was the curator.

Woody: Was that the technological section? What was the section?

Bill: I think my title was "Technical Curator."

Woody: And how did you get to that title?

Bill: I was working on the peninsula at Sygnetics and I had developed a . . . for a long time prior to that I had been working on this color lissajous display, x-y . . . essentially a wide band x-y color oscilloscope.

Woody: Did you use a standard television tube?

Bill: Yes I did but I had to go back even further. I got the idea . . . somebody else in New York had done it long before me, and I saw what he had done.

Woody: Do you recall the name?

Bill: I do not recall the name, but he was well known.

Woody: Sid Washer?

Bill: It could have been him, or somebody like him. But I saw this device; I think it was in '67 or '66 . . .

Mrs.: '65.

Woody: You saw this in somebody's place?

Bill: Yeah, somebody's apartment, an old friend of ours. It was rather crude. What I saw was just a smear but it occurred to me that . . . I would say '66 . . . it was rather crude and the bandwidth . . . but I could see instantly what it was. It was an x-y display. So I decided to do it rigorously.

Woody: In what context? Through whom did you meet this person that you are describing?

Bill: Larry Shaw was the person who was Instrumental.

Mrs.: They have a friend who happens to be the daughter of the publisher of the New Yorker, and I don't know who that is.

Woody: Can you give me one name.

Bill: I can tell you what the TV was. It was a General Electric, early General Electric portable. It was the cheapest one they made at the time.

Mrs. I think that was Daisy Pardine.

Bill: Daisy, she's married to Sandy Bull, right? Sandy Bull's sister.

Woody: Are they still living in New York City?

Bill: I don't know.

Woody: Who knows them from people we know.

Bill: Oh, I'd have to look . . . Anyway, the technical . . . technically I saw that it was kind of a nice concept, and the set would switch back and forth. TV or . . . When I developed it I improved the deflection amplifiers to give a really good response and I developed a system of color modulation which I have a patent on. What it did it painted color on the surface according to the convolution of the surface. You get these very beautiful . . . You saw it when I had it.

Woody: You have mostly based on circles display, but you have multiples of circles.

Bill: Well, it could be squares, circles . . . (I also have some 16mm film that shows it in motion).

Woody: What control modes do you have on it?

Bill: In fact, the synthesizer that I built is now over at the Exploratorium. I donated it.

Woody: It's the original?

Bill: It's the one you saw when you were there in '71.

Woody: Which version was that?

Bill: That was the last, the final solution.

Woody: Where are these versions?

Bill: Well, one of them's in my back yard getting ready to go to the dump right now. The first one. I almost loaded it into the trailer today.

Woody: It was monochromatic?

Bill: Yeah, it was monochromatic. The thing is that the monochromatic versions were beautiful. They were very lacy and sharp. They had a very sharp trace on the electromagnetic CRT. And if you can deflect the beam, which is very difficult, it takes a lot of power and very good amplifiers to deflect an electromagnetic CRT, when you can do that it turns out . . . when you really try to equalize the amplifiers you can get beautiful patterns. Even from voice or recorded music or anything like that.

Woody: What was the heart of it?

Bill: Well, I'd say it's an x-y lissajous display with color modulation designed to follow the contours of the pseudo-three dimensional image. It forms patterns sometimes, which are like Escher pictures, which are impossible objects.

Woody: You can generate objects.

Bill: That's true, objects which are even impossible in terms of their contraries (??). I tried to . . .

Woody: Your amplifiers must have been capable of being modulated in a way that they could follow a square or a circle. There must have been some very good modulation.

Bill: Very powerful amplifiers.

Woody: That means that these amplifiers were capable of accepting various modes. Did you have names for those things?

Bill: Well, deflection amplifiers.

Woody: Yeah, but you didn't have a particular language developed?

Bill: For that? I don't think that I had . . . I usually stick to the conventional engineering names for things. I feel comfortable with those.

Woody: For example, you would use multiplier, or amplifier, or color modulator?

Bill: Or color modulator. Some of the terms I used were deflection amplifiers, color modulator, I did use multipliers, squaring circuits, square root circuits. You see, the basic trick is that the color is a function of the velocity of the trace as it moves on the screen. As the trace moves the color stretches towards the red end of the spectrum. You know what the spectrum looks like. It starts at red and goes through orange, yellow, green, blue and then it gets into violet. OK? I assigned colors according to the actual velocity of the trace on the screen. I had circuits which could measure the velocity and change the color of the dot as it was moving, and in doing that it made the contours of the image stand out in a really interesting way.

Woody: I see. The color was specified by the velocity of the trace. That means that your set was R-G-B? Standard R-G-B.

Bill: Oh no. It was R-G-B at the guns of course, but I had . . . I used several techniques to trace a circle in the chrominance. Now I know much more about it and I'm kind of embarrassed at the way I did it. But I did simply make a vector that rotated and it gave R-Y, B-Y axes rotated as the vector rotated in that plane of R-Y, B-Y. And there was a luminance component, which I wasn't too careful about. But the vector would rotate as a function of the speed of the trace. The absolute velocity. To measure the absolute velocity was very simple. I had the x velocity which was the equivalent of the differentiated signal into the X amplifier. And the y velocity, which was a function of the differentiated signal into the Y. So giving those two velocities, all I needed to do was to take the square root of the sum of the squares and I would have the absolute velocity.

Woody: Is this on paper?

Bill: It's fully described in the patent.

Woody: Now we have reached the third version or second version?

Bill: I haven't worked on it for ten years. I'm sorry, it hasn't been that long. It's been about six or eight years since I've done a thing on it. Because it was such a dead end. I found it was quite interesting and beautiful, but first of all it had no commercial application, because I found that people in special effects, in film or advertising, all have very tried and true techniques that they stick to. They don't want anybody coming and disturbing their nice game. That's very difficult. I tried to break into advertising and I found that I was not very skilled at the politics of it for starters. I had a terrible time.

Woody: Maybe you could sketch very briefly your background. You have a degree?

Bill: Oh yes, I have a degree from the University of California in electronic engineering.

Woody: What was your hobby?

Bill: Electronics.

Woody: It wasn't particularly visually oriented?

Mrs.: Well, don't forget EAT. That was right after you started getting the color version.

Bill: When did EAT come along?

Woody: You mean experiments in Art and Technology?

Bill: That's right. See, they came along just when I went to The Exploratorium.

Woody: It was 68 probably.

Bill: I guess 68 might not be too far off.

Woody: I see, you actually joined . . . this was your connection to art.

Bill: A beautiful lady in New York, by the name of Suzanne Ciana was very much involved with EAT at that time. She was out here, now she's in New York. She does commercial and other work on her synthesizer. She was one of the people who, and I forget the name of the woman, really spectacular female who was the teaser of the group that came out. You would recognize the name immediately.

Woody: What was this girl's preoccupation? What did she do?

Bill: She organized it out here and she's one of these showy people and she was into video a lot. And she had a video show down at the Museum. People would come in and they'd take Polaroid pictures of them.

Woody: Like Shirley Clarke or Jackie Cassen?

Bill: Alan Shulman would know.

Woody: What's the position of Alan Shulman, because he was involved with Video Free America?

Bill: Well let me go through the chronology of it. See these were two separate things. I never mix them very much.

Mrs.: You were interested in EAT because of what you were doing and said "Hey, I'm doing something too."

Bill: Except for my background and I had learned television at least technically, I had never been interested in television until somewhere around the time when I met you. Some people in Berkeley asked me to make a colorizer for them, people at Video Free America: Arthur Ginsberg, Skip Sweeney and Alan Shulman.

Woody: How did they find you?

Bill: I guess this must have been through the Exploratorium. Could have been EAT or the Exploratorium. So they asked me to build this colorizer about that time and they showed me that they had a colorizer. When they opened it up all the parts fell out. It was a little thing in a gray box about this big and it cost, you know, \$800 and it had two knobs on it. Kind of made a smearable color. And I said, "Gee, we could do better than that." So at that point I had evolved the concept of the zone colorizer. I said what you want to do is cut the gray scale in segments.

Woody: Into zones.

Bill: Well, that's a good way to put it. It's a multi-level colorizer, which is like a multi-level keyer I guess. A colorizer which cuts the luminance scale into sections. I used the word zone, because since then I've learned the Ansel Adams system a little better.

Woody: Can you describe that?

Bill: Well, he's a photographer, and he has a technique where he measures the luminance of what he's photographing and divides it into what he calls zones, which I believe the luminance doubles when you go to zones, and he says that you divide the total range of discernable gray scale into ten zones. And it's a logarithmic progression. In other words - it doubles as you go ... the brightness doubles. So, the luminance of a video signal can be split in the same way. It doesn't have to be every time the luminance doubles. In fact, in the colorizers I make you get to slice the gray scale at arbitrary points.

Woody: The relationship is linear? You said something about logarithmic.

Bill: I'm not clear about that to be frank with you.

**(skip a little stuff here about documentation of zone system)**

The concept is that you slice the gray scale, essentially. I sat down and I said, "What's the best way to take a colorizer, at that point, and it occurred to me that what you wanted to do was to be able to assign an arbitrary color and brightness to any segment of the gray scale. You pick it out and you assign it. It would be the only way to do it. So I worked on that, and I made one colorizer which was terrible but it sort of worked. And I made three or four more and started confronting the basic problems of this which, in terms of the user, things like gen-lock . . .

Woody: Let's return to this colorizer later. If I may ask you, who did the first Vidium?

Bill: I'll tell you the total story behind that. I paid for all of it myself up to the point where I got some exposure and a very wonderful man named Al Leavitt here in San Francisco, who later turned out to be a kind of pain in the ass. A very well known entrepreneur saw it.

Mrs.: He used to have a classical music Station.

Bill: He used to have the best classical music station in San Francisco, KSFR, and he was an immaculate man. He saw it, and he loved it, and he said we should exploit this. I said, 'fine,'

and he made a contract with me through negotiations with my attorney who had already filed . . .

Woody: Do you have the documents?

Bill: I have some of the documentation on that. And we formed the "Color Communications Corporation" and Al put in \$30,000 and I put in my patent and he died. And he left all his money to the San Francisco Foundation, which was also interested in the arts.

Woody: It wasn't spent, the money?

Bill: No, I got the \$30,000. I never would have been able to do what I did if Al had lived, that's the funny part of it. Al died of a heart attack.

Woody: In the middle of the project?

Bill: Basically in the beginning of the project. And the money was in the bank and I went ahead and built this thing you saw. But I never had the ability to exploit it commercially like Al would have. Al was a businessman, and he was very successful.

Woody: The corporation, you might eventually have . . .

Bill: I might have, but you never know dealing with these sharp people. After I dealt with him I had a kind of prejudice against business people. You have to be very careful. I'm a technical person. I'm not a business man.

Woody: So, who sponsored the next generation?

Bill: That was the last one.

Woody: That was the most developed.

Bill: Up until that time I had done nothing. I had only done it on my own.

Woody: Is that described by other people? Is there, any literature existing on this particular model?

Bill: No.

Woody: But the model exists still. It works?

Bill: Oh sure.

Woody: And it's being used? People are turning knobs daily?

Bill: I don't believe they've got it set up over there. Larry Shaw was my assistant at the time. He's an old friend of mine and he and I went to the Exploratorium I brought him in. He asked me to donate it. And I put it on loan for a year. I think the year is almost up. I don't believe they've ever

put it out on the floor. I do not want it to be out on the floor, because things like that can be really ruined if they're exposed to the public and kids come and turn knobs endlessly. I meant it to be something for an artist or a creative person. I try to make all my tools for creative people. That's my primary impetus.

Woody: But going back to the question. There isn't any precise description, there's no how-to, there's no documentation of . . . any description that some one would be able to get?

Bill: Oh: no. I just don't have manuals for it because I never produced it. I meant to train somebody to do it in the end if it could be used commercially. I hoped it could be used commercially and I must say, looking at it today, it's a very good piece of equipment. I think it could be . . . We were lucky enough to have some people working for me who were very good at what they did. They put it together really well.

Woody: Did you know about video, so to speak?

Bill: I knew about it because I'd taken it in school. I was a technician.

Woody: You didn't know-about people doing small format recording?

Bill: No.

Woody: Well how did you stumble over this Video Free America? They found you at the Exploratorium.

Bill: I'm trying to remember whether it was EAT or the Exploratorium. It was one or the other. You see, EAT was also tied up with the Exploratorium, because at the beginning, Frank Oppenheimer was the director, had a lot of emphasis on art as well as technology. Now . . . that was one of the reasons that I split from the place, because it was more oriented toward technology than art. I wanted a synthesis of art and technology. That's what I was willing to work for.

Woody: At the time, what were your ideas about composition? What kind of instrument would it be? Would it be performed, or would it be a home device?

Bill: Somewhat of a real time instrument. I did it real time, but most of the things, like the Videolab, it's not . . .

Mrs.: You were ding concerts at the Conservatory of Music.

Bill: That's right. Oh I left out a whole pile of things. Through EAT, I met a number of budding electronic music composers. Two, which are good friends of mine, Alden Jancks (**sp**) and Martin Bartlett. I helped them build music synthesizers. And when I developed the Vidium, they found it was a really sympathetic way of producing images through their electronic music, just directly from their signals and getting a visual synthesis of what they were doing.

Woody: Did you do any performances?

Bill: Yeah, we did several live performances at the Conservatory.

Woody: Is it documented?

Bill: You can ask Alden. I think it was published.

**(short break for factual questions about- EAT)**

Woody: Who of the musicians got really interested a little bit beyond the average? Is there any character you would find more interested than the others?

Bill: Don Buchla came by for a few meetings, and of course everybody knows Don Buchla. Probably the most famous of all of them. I think David Tudor was very interested in it. David Tudor could tell you a few things about EAT. The people that I had a lot of fun with were Martin Bartlett and Alden Jancks. I think Alden is probably still teaching at the Conservatory of Music in San Francisco.

Woody: What was the date of the last Vidium?

Bill: I think it was 1970.

Woody: Because when we met you it was already in operation for at least a year?

Bill: I think so.

Mrs.: Maybe it was early '71.

Woody: How did you make the connection to Video Free America and the colorizer?

Bill: Well, as you're probably aware, it's a completely different medium. It has nothing to do with video, because it's a doctored television set. Somewhere along the line, I saw that Nam June was doing the same Stuff in New York and I had a couple of laughs. In '68 I guess it was in a TV Guide, his version of it, which was kind of anarchistic. Had the good fortune . . . Suzanne is well acquainted with Nam June and she introduced me to him. It's the only time I ever met him. I was on a trip to fix an old colorizer in '73 probably. In New York City. I just ran into her on a corner, you know you do that in New York City. And she was giving a concert and Nam June came along and introduced me. I only mentioned that because he was doing the same, he was also doing; this lissajous thing with a TV set.

Woody: You hadn't met Abe, by any chance?

Bill: I never met him. I heard that he's been in and out but I understand he's in Japan or something, or was.

**(break here 420)**

But how it got over to video was just . . . the thing that really made it happen was the Video Free America people came and asked me to make a colorizer. And then I searched and analyzed what was really needed, which is what I do. Even at that time I had been working with artists enough to try to talk to them for a while and second guess what they really needed. What controls would give them the most freedom. So, the concept of the multi-level colorizer may have been done by other people, but as far as I was concerned, it was original with me.

Woody: There are a few colorizers before you, but they are mostly continuous hue modulation.

Bill: Yeah, another thing was the hue saturation and gray. I decided that even though it was much harder to do than R-G-B or the other approaches, that that was the most effective in terms of human engineering, what people could do. So I decided to do it that way. And that lead to more complex circuits and more difficult circuits, but that was manageable in the end it became not too hard.

Woody: So let's say the zoning . . .

Bill: That was my idea.

Woody: Now what you're saying is the addition, to mix in the luminance . . . or what are you describing now as more complex? What would you find out as extra features that you added into this? Because the zoning is probably the most crude way.

Bill: Adjustable zoning. It's a question of being able to set the break point on the gray scale that you see on the sliders here. You set the point where it breaks into a different segment of the gray scale. That way you can separate out. So some of the main ideas were zoning the gray scale, cutting it into zones, generating a totally synthetic image by means of arbitrary hue saturation and gray. And being able to mix that in varying amounts . . .

## **(Side 2)**

make another colorizer that doesn't have variable hardness on the transition points.

Woody: The zoning became a soft transition . . .

Bill: A smooth transition between zones.

Woody: That would be an extra feature. It would be a knob, or would it be a switch?

Bill: Hardness. The Videolab, which is still the best colorizer I've made, has a variable edge on each edge. When you take something and you slice it three times you get four parts. So each of these gray points is controllable in its hardness.

Woody: This was an accumulation of all the experiences so far?

Bill: It is truly a natural result, but I'll tell you how that happened. But I should first say that I went through a series of colorizers.

Woody: Right. Why don't we go through that? That means that the first colorizer was requested by Video Free America. I know the first machine is still there.

Bill: It's still there. Did you see it? It's in a big piece of wood. Alan Shulman built it now.

Woody: What happened since that first machine? That was what year?

Bill: I think it was '72 I guess when I first made that one. And then I went to work for . . .

Woody: Who paid for this machine?

Bill: I don't know if they paid me at all. You see at EAT I had gotten into just designing things for artists and letting them build it. I didn't mind, because it's easy. I can sit down and design something in 10 minutes, usually. And it's fun. And I was getting a lot back from people because human values was really a nice trip to deal with artists, being an engineer. So I think I probably did the first one for free, and that was the prototype breadboard that that you saw. And then I eventually developed . . . at this point I started working for another company in Berkeley called Cinemax and we were generating a special effects film, an automated film machine, which turned out to be a big failure.

Woody: What was it supposed to do?

Bill: This was supposed to do automated special effects on film.

Woody: Electronically?

Bill: Electronic memory and it was . . . but a lot of optics mostly and the electronic memory and a lot of servo systems and zoom lenses and things like that.

Woody: Stepper motors?

Bill: I never use stepper motors. I guess we used stepper motors on the shutter pulldown. But at that time I met my business partner, Holly, and I think we made our first Model 100 colorizer.

Woody: You were already Electronic Associates of Berkeley?

Bill: No, we called it the Electronic Co-op.

Woody: That's a second company I hear?

Bill: That was my first company, my first independent company except for Color Communications which I formed with Al Leavitt to make the Vidium.

Woody: But you were a partner there? or vice President?

Bill: You see, me and Holly and a couple of other people were over at Cinemax and it was kind of falling apart . . . and eventually I lost my job at the Exploratorium because I wasn't showing up enough and I sort of disapproved of their basic scene. While we were at Cinemax we started what we called the Electronic Co-op, which was that we would put stuff together and everybody would share in the profits, and we had like three or four people. Several things happened. Cinemax folded and the other two people dropped out and there was just me and Holly left. So we pursued the 50-50 policy since then. Holly Childhouse. After Cinemax folded, I think we made our first colorizer for Skip Sweeney and one or two other local people and some New York people.

Woody: How many of that generation did you make?

Bill: There must be at least ten of them around. The Model 100 Colorizer.

**(chit chat here, break but Hearn indicates that Gary Schroeder has a model 100. Woody asks if he knows Phil Gietzen and Bill doesn't)**

Hearn continues: It used a hard-edged key with a four level . . . hue, saturation and gray and a knob to mix the effects and a normal knob. So you mixed in the original.

Woody: What was the price?

Bill: The price was \$1,300. Except when we started putting in gen-locks and external subcarrier we would add another hundred or two-hundred dollars for it. We did that for a couple of years and developed things and in the meantime we started making some more complex colorizers which I immediately stopped making because we went through a couple of generations. Of course I taught Holly how to . . . she knew nothing about wiring things and I taught her how to do it. She would build them, just much like it is today. She builds them and I check them out and we split it.

Woody: What were the extras that you dropped? You said that the colorizer became more complicated.

Bill: Well, sometime around the time that you got your model 200, I sold another one to Jack Bice I designed that colorizer but it was somewhat faulty in the concept. In other words, I was getting a little sloppy in the way I was putting them together and it was too complicated for Holly to do properly and other things were happening that made the energy a little strange. It just didn't work. That was like the last new development in colorizers. I shouldn't say that because every so often someone calls up and wants a colorizer and I make it for him. Like I just got one for Adwar. You had the model 200.

Woody: At that time the company was called "Electronic Associates of Berkeley?"

Bill: Somewhere along the line Holly didn't like the name "Electronic Co-op" and her father suggested that we rename ourselves "The Electronic Associates of Berkeley," which we did.

Woody: What kind of company are you now?

Bill: We're a partnership, me and Holly.

Woody: And what happened then?

Bill: Well, right after your machine a very interesting thing happened. Right after the machines I made for you and Jack Bice I was a little ashamed of the way they were put together and I still am. I'm trying to get them out of circulation, so that's the way it goes. But a funny thing happened. Bill Etra and Steve Rutt called me on the telephone, kind of a conference call, and somehow they had gotten my name and heard about me, and they told me that they wanted this and that and we talked for awhile. Bill had started out saying he wanted a voltage controlled colorizer and a . . . and I told him I could build him a matrix switcher that with linearly controlled cross-points. In other words, you put in a variable voltage and it will bring in that input line on that output line. So he said . . . and eventually it happened through several conversations between me and him and Steve on the phone that they wanted . . . I suggested they put it all in one . . . the voltage controlled colorizer, the voltage controlled switcher and then somebody came up with the idea, I think it was Bill, they also could use some oscillators. I guess you know that the Rutt-Etra uses a lot of oscillators. And something snapped in my head and I said, "What you guys really want is a synthesizer that has all these things and is capable of doing all the standard special effects." So I sat down and . . . it was really a terrific thing to think of, to reduce everything in video to a few little modules that could be interconnected and produce all the standard effects. I had to ask myself, "What do you do when you make a wipe? What do you do when you make a key? What do you do when you make a split screen? What do you do when you do all these things?" And I had already had a lot of experience because of the colorizer and I already had a lot of experience because I had made a lot of voltage controlled stuff for the music artists that I had been working with. You see, I was really steeped in voltage control.

Woody: Do you have a list of those effects in this black book? All the effects you are seeking or were uniting?

Bill: Let me see if I can go back into the early black books here. September 7, 1975. Here's the video switcher that I designed for Etra. He wanted a 100 point matrix video switcher. That was July of '75. And I had already made the front panel sketch. The switcher never materialized. The earliest thing I find in here from that. This is what was supposed to be a hip switcher. This is what Adwar now sells as a hip switcher. I could have developed this but . . . people were asking me to do it. I think the first really important thing here is this design for the hundred-point matrix, 10 in-10 out. Eventually he didn't want it. He wanted something more and I said "Look, I'll tell you what. I'll put it all together in one box or two boxes and then I'll sell it." He said "Terrific." I said, "OK, you'll have oscillators; you'll have a matrix switcher, you'll have a colorizer and you'll be able to generate all the standard special effects."

Woody: Just going back to the matrix, it was . . .

**(break here, while H explains VC matrix)**

Bill: . . . when you put a voltage in at the cross point . . .

Woody: a voltage activated cross-point.

Bill: That's right. Linearly, it's a two-quadrant multiplier, which is to say that the amplitude of the input voltage brings up the output proportionally . . .

Woody: By the way, is this book publishable? Eventually?

Bill: Well, there are proprietary things that I'm still trying to make a buck out of, but certainly something this old, you could . . . but you'd have to tell me in more detail what you'd like to do.

Woody: For the future, just inquiring.

Bill: OK, keyer/fader. Four level variable gain keying. I was thinking about it even then. And I guess we called ourselves EAB, even in August '75. This was a kind of switcher that somebody wanted, a very interesting SEG but I never built it. Here's where I started building the Videolab which, I would guess was September of '75. Here's my write up of what the system should be . . . August 23 of '75. "There are three types of signals in the Videolab system: logic, control and video. Logic signals are zero and plus five, later they were 0 and + 2.5; control inputs are either unipolar or bipolar, that's not true, they're now unipolar only. So that there are small changes in that. I set the subsystems; linear keyer, colorizer, keyer and special effects control sources, output mixer/fader. They changed a little.

Woody: Do you have any memos between Bill and you, or was it all informal?

Bill: It was all informal. Here's what happened. I'm trying to find the exact date. Here we are in August 31, 1975 . . . What happened was, after some negotiation on the phone he said, "Why don't I come out and talk to you?" I said, "OK, I'll have a panel drawing ready for you." That panel drawing was this. Was identical to this. It hasn't changed, hardly at all.

**(I skip a few sentences)**

When he came out I had made the basic drawing/design from what we had talked about. He only changed one thing. He insisted that the colorizer have all voltage-controlled inputs. I had wanted to put a minimum voltage control on because it could have been much more cost effective. We would have been able to sell many more units . . . but he's very uncompromising so he insisted that we add all these. That cost me two or three months in the design, so I went back and changed it. But otherwise it was just like this. When he stepped off the plane, we handed him the blueprint of the front panel. And I had never met him, of course.

**(skip some chit chat here)**

We went through several generations of practically every circuit in the Lab. Good and bad. Some of the early ones were pretty darn sloppy.

**(skip some stuff while Woody makes proposition to Hearn)**

Hearn agrees, indicates that he could make block diagrams of the Videolab and wouldn't mind publishing it.

Woody: Let's go into the other kind of overall social involvement. By that time, when you started to build the Videolab, did you in any way make money for yourself? Could you actually build it as a business, or was it . . .

Bill: Because I never got any outside money in the company, it was very slow. And even at this point, where the circuits in the Videolab itself are satisfying to me, personally I feel that they do what they're supposed to now, we still aren't really a huge success or . . . it depends on how you look at it. If a tree is only six inches tall, it is a failure? No. I feel that it's an evolutionary thing . . . To make this product and this company work, I've been going very slowly and I haven't accepted any outside money or anything like that. It's all been bootstrap, totally. It's provided Holly a good living and a lot of satisfaction and all that, so--

Woody: But you have to have a job on the side, you can't live on that?

Bill: I don't feel comfortable unless I have a mainstream kind of engineering job. I have a family and I have to be careful.

Woody: You have a job at Berkeley?

Bill: Lawrence Berkeley Labs. Besides, I became an engineer to accept a large variety of problems and I want to be very current and I want to be always on the edge. And at Lawrence Berkeley I have very challenging kinds of circuit designs problems in many different areas of electronics.

Woody: What is your title?

Bill: I'm an electronic engineer.

Woody: There are many or few?

Bill: I don't know how many circuit designers there are. There are a lot of engineers and there are not that many circuit designers.

Woody: Going back, do you think that Etra influenced the concept of-this?

Bill: I would agree with you that he . . . and me and Bill, we never really totally agree on who did what, but I know that I designed that panel and I conceived of the different blocks. Aside from the matrix switcher and the colorizer, which he originally suggested. And I did all the details on them, also. And I conceived of the signal system and things like that. And who knows how much of his intelligence was unspoken in back of it all. I would give him credit for a lot of the energy that came behind it.

Woody: How would you characterize him?

Bill: As a person?

Woody: No.

Bill: As a designer?

Woody: No. As a person involved in tools.

Bill: Oh . . . Bill Etra is a video artist and a real idea guy.

Woody: What would his importance be?

Bill: In the machine?

Woody: No, generally. In this machine and other machines.

Bill: Oh I see what you're saying. I can only judge him from my personal relationship. I get the idea that he's pretty well known and he's a promoter.

Woody: He has access to money, for example?

Bill: He has access to money too. There's a lot of things that I just don't do. I'm strictly a technical person.

Woody: So you think he's a vehicle in fact for your ideas?

Bill: My relationships with Bill is so complex that it's hard to talk about.

Woody: I don't want you to say yes or know. I have also the same problems with him as you do or the same . . . it's very complex. I'm just trying to define his role.

Bill: I think if you wanted to define his role in the Lab, I think you'd say he asked for the original one, he put a lot of energy into it. I take credit for the detailed design and also for a lot of the way the thing is sliced up. And doing it, of course. The more I look at it I see little things that could have been done differently, but I would say that panel is mine and the circuits inside are mine. Again, I can't really pin down how much of his energy really went into it on that unconscious level. So it's conceivable that you'd have to give him credit for a lot of this. He had all that energy you know.

Woody: What other influences can you trace?

Bill: Don Buchla. Buchla was the strongest influence I ever had in terms of the way he did things. If you look at this you'll see that it's totally similar to his synthesizers in the philosophy of what it does. Control voltages, logic voltages, signal voltages. It's split up into three separate things. The

only thing I didn't do was I used strictly banana jacks, and that's a very important point. Unshielded banana jacks, so that you can stack them, which makes the flow much simpler and easier. But I think technically you can say that this machine could have been designed by Don Buchla.

**(laughter)**

Woody: You see, Dan Sandin professes to the influence of Moog. And your device is basically of a different generation of intelligence. It's generally kind of more specialized but more complex and closer to the digital bridge. His is, in a way, quite traditional.

Bill: Oh, he does things like not putting labels on his knobs.

Woody: Yeah, but also his modularity and rigidity containing each module as the expression of the technological functions.

Bill: This is frankly commercial. The object of making this was to make something for small production houses so that they could gen-lock to a tape machines, bring in several video images from cameras, lock them up, put on titles, colorize, do a number of little effects and actually use it as a small post-production unit. It's been done. It turns out that the artists were really the ones who went cuckoo over it and started ordering it. It's kind of a disappointment to me but that's life.

Woody: So, you'll get your glory but no money.

Bill: I'll get the money eventually.

**(skip a bit of chit chat)**

Woody: Have you ever written about esthetics? Even if it was a total failure or a total success?

Bill: Yeah.

Woody: Something that you described how the tools could be used?

Bill: I have recommendations in here (the user's manual) on ... esthetically I say really simple things like, "If you're going to colorize, don't run the saturation up too high, mix in the original image and overlay the color on top of it." That's the kind of advice I give in general.

**(skip a little chit chat to end of tape)**

Hearn: I think about the person who made organs for Bach, the person who designed and built them. And what I want to do, what I really lust after is to make machines that are so clear to a creative person and give them so many possibilities that they can use them. That it gives them freedom as an artist. And I got that from working with the EAT, the Experiments in Art and Technology. Where I began to talk to these people and get a little glimpse of their creative drive. And it just gives me a terrific thrill when I see someone like Ernie Gusella in New York who's doing truly creative work with the Videolab. And it's always in the back of my mind whenever I

make a new one . . . It's like putting the keys on an organ or how many pedals, or how many stops, how close they are to the keyboard. What's the most elegant way of giving tool control to the person who's using it.

Woody: So, you consider yourself as instrument builder?

Hearn: Yeah, That's exactly what I do. Undoubtedly, some of these guys could play the organ, and I can run a Videolab a lot better than somebody who's never tried it, but I'm not as good as a lot of guys. Etra's faster than me and a lot better. Ernie Gusella and other people, Howie Gutstadt is really, really very advanced on the machine. That's the way I look at myself and I feel good about that. Someday I'd really like to get started doing the other side of it, the creative side.

Woody: So you want to eventually also make your own work?

Hearn: I'd like to give it a try.

Woody: Is there any ambition of yours to actually work or produce art?

Hearn: I'm so happy with the circuits. I get incredible satisfaction out of some of these drawings.

Woody: You mean you provide something for the people?

Hearn: And I get the satisfaction . . . Well you never know. If you look at this, I'll try to pick one. If you look at some of these drawings there are years of work in the background of these things. And when I sit down and draw them it's like there's nothing but me and this piece of paper. This is the new Lab. And I just, actually it's like a real thrill, that's a creative shot in the arm whenever I sit down and make something new. Especially knowing that . . . And you see that they're all drawn so that they can be easily built. The I.C.s are all put out in place right next to each other and the signals can be traced very clearly, and to me it's like a creative expression. So I get enormous satisfaction just out of this end of it. Not just the \_\_\_\_\_ of the detail, I go down into the details as far as . . . I find that you have, to be successful, you have to get involved with all of the details be very . . . you have to be very careful and get down everything, follow every detail. But then you can . . . after you conceive of that you just make the drawing and the I.C.s are all in place and the signal paths are clear and the parts are all well known and predictable and . . . So to me, this is my creative kick. Eventually, sure, maybe if I get tired of it, I'd like to . . . but to me it's enough of a thrill to see somebody doing work on it, like Ernie or Howie . . .

Woody: I'm curious, because there is this confrontation with digital.

Hearn: Oh digital, ah yes.

Woody: And then after that there will be some . . .

Hearn: I've been known to get very salty and unpleasant about digital because as an engineer . . . you have to understand that I'm an industrial type electronics engineer running with some fairly heavy people. And it's been my experience as an engineer for fifteen years that there's always some

guy who says "Digital is the way it is, you can do everything digitally and that the world is digital and that it is all going to happen tomorrow and it's all going to become digital and stuff like that. I learned digital.

### **Wife interjects inaudible stuff**

At the lab I interface all of the sensors to their computer, in and out, at the Rad Lab. And they have a giant computer that they stuff everything into and it number-crunches everything and then they have to get it out. But out in the interfaces where the difficulties are, and getting information in and out, the software for the information when it's in. It's not as simple as digital, you know, as people think.

Woody: So what you feel is the most sensitive parts . . .

### **Wife interjects inaudible**

Hearn: Oh yes, at the Lab they have these big accelerators and the physicists run them and some guy got the bright idea that you could just put it all into a computer and work it with a teletype. And you tune all these big magnets and stuff and the accelerator and drift tubes and things like that. And there are maybe 200 variables in this linear accelerator that people have to tune. So they put it all into the computer and they took away all the knobs and they gave them a teletype and they said, "Here it is folks." And the physicists came in and said "Where are the knobs!?" They wouldn't touch it if it didn't have knobs on it. Finally they put the knobs back and they put an A/D converter on every knob. That's why knobs are on here, because it's a knob machine. In terms of human engineering I think that's a really important thing. People have instant access, it's tactile, it's something . . . you know, through their fingers, the interface is clear. Some people have the interfaces through their minds, they make a program. I've seen some of your stuff. To you it's not a tactile thing, it's a mental thing. You put it in and it makes it.

Woody: I come from such a tactile background. I used to play violin and all those things. I know it can be done with the hands, that's not a dilemma. But it can not be done with the head only, that's what challenges me tremendously.

Hearn: It can't be done with the head only; you want to do it with just the head.

Woody: You still have to compromise, but there is no preference. We are all going into digital just to bounce back or bounce in the middle. Dan continuously holds that there will be a hybrid system.

Hearn: Why yes, that's all there is.

Woody: That's right. He is making extreme sense.

Hearn: I agree with him 100%. Hybrid is the only . . . practical system is a hybrid system. There is digital and analog in the Videolab. But it's basically analog; I have to agree with you on that. But even a system that's basically digital has to have a lot of A/D on the inputs and outputs.

Woody: It's hard to predict, digital is now trying to . . . there is an enormous investment in the components and everything. And people hope that that's going to solve something. But eventually as far as image is concerned, it hasn't made much change so far. But I can foresee working with Etra that there will be a few more effects that will be generically . . . like especially in the transition between two images. It's not a single image, you can do everything on a single image in analog systems, but in transition it may have some significance.

### **(down hill from here)**

Bill: I must admit to the grossest kind of prejudice in my field as a professional engineer, dealing with digital engineers who are very narrow-minded about ways to do things. I know that video can use all of these things but I'm always coming up against my past experiences with guys who thought that all there was was digital. And in the end I think it's narrow to say all there is is anything. All there is is electronics and memory, and information right now is a terrifically big thing. And it's going to be bigger. It's taking us into a whole new kind of doing things.

Woody: In digital there is a hope to get a score. It would also be some sort of security. For analog, it requires high skill. It's not easy to work with analog systems. Some people get very good at it by practicing. You cannot just approach this tool and do a masterpiece. It in fact takes years of experience to use analog devices. So that digital has some hope of having a library. It suits this easy access to library because it's possible. That is one advantage which digital will have because these tools will be very much unique because digital tools aren't so unique. These express very much the personality of the person who created them. There's no tradition in the sense of . . . There's only tradition's experience, and skill will die with people that die. The operators or artists that master it. It wouldn't get passed on as a score.

Bill: But a patch, all you have to do is take a picture of it or you can describe it digitally. It would be easy to encode a patch. I think that might take, maybe, only 200 bits of information to code each of these patches. Suppose more, suppose a thousand bits. You know, that's nothing.

Woody: That's an interesting thought. You had better add a score module and then we can talk about something that can pass on this kind of experience. But it's very hard to expect that knowledge be accumulated. That's something for you to think about. How to pass it on. How to assemble a library that is craft oriented. A library that is of the craft of this tool.

Bill: Software.

Woody: It doesn't have to be called software. But it's something like software.

Bill: It's a good term.